(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization International Bureau



(43) International Publication Date 8 July 2004 (08.07.2004)

PCT

(10) International Publication Number WO 2004/057684 A1

(51) International Patent Classification⁷:

H01L 45/00,

(21) International Application Number:

PCT/IB2003/005648

(22) International Filing Date: 3 December 2003 (03.12.2003)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

02080430.8

19 December 2002 (19.12.2002) EP

03100583.8 7 March 2003 (07.03.2003)

(71) Applicant (for all designated States except US): KONIN-KLIJKE PHILIPS ELECTRONICS N.V. [NL/NL]; Groenewoudseweg 1, NL-5621 BA Eindhoven (NL).

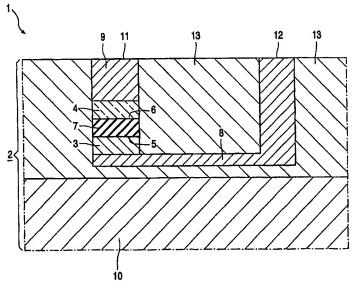
(72) Inventors; and

(75) Inventors/Applicants (for US only): LANKHORST, Martijn, H., R. [NL/NL]; c/o Prof. Holstlaan 6, NL-5656 AA Eindhoven (NL). VAN PIETERSON, Liesbeth [NL/NL]; c/o Prof. Holstlaan 6, NL-5656 AA Eindhoven (NL). WOLTERS, Robertus, A., M. [NL/NL]; c/o Prof. Holstlaan 6, NL-5656 AA Eindhoven (NL). MEINDERS, Erwin, R. [NL/NL]; c/o Prof. Holstlaan 6, NL-5656 AA Eindhoven (NL).

- (74) Agent: DUIJVESTIJN, Adrianus, J.; Philips Intellectual Property & Standards, Prof. Holstlaan 6, NL-5656 AA Eindhoven (NL).
- (81) Designated States (national): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.
- (84) Designated States (regional): ARIPO patent (BW, GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO, SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

[Continued on next page]

(54) Title: ELECTRIC DEVICE COMPRISING PHASE CHANGE MATERIAL



(57) Abstract: The electric device (1, 100) has a body (2, 101) with a resistor (7, 250) comprising a phase change material being changeable between a first phase and a second phase. The resistor (7, 250) has an electric resistance which depends on whether the phase change material is in the first phase or the second phase. The resistor (7, 250) is able to conduct a current for enabling a transition from the first phase to the second phase. The phase change material is a fast growth material which may be a composition of formula $Sb_{1-c}M_c$ with c satisfying $0.05 \le c \le 0.61$, and M being one or more elements selected from the group of Ge, In, Ag, Ga, Te, Zn and Sn, or a composition of formula $Sb_{1}Te_{b}X_{100-(a+b)}$ with a, b and 100-(a+b) denoting atomic percentages satisfying $1 \le a/b \le 8$ and $4 \le 100-(a+b) \le 22$, and X being one or more elements selected from Ge, In, Ag, Ga and Zn.

WO 2004/057684 A1



Declaration under Rule 4.17:

as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii)) for the following designations AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, UZ, VC, VN, YU, ZA, ZM, ZW, ARIPO patent (BW, GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT,

LU, MC, NL, PT, RO, SE, SI, SK, TR), OAPI patent (BF, BI, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG)

Published:

- with international search report
- before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

ini nal Application No PCT/IB 03/05648

A. CLASSIFICATION OF SUBJECT MATTER IPC 7 H01L45/00 H01L27/24

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols) IPC $\,\,$ 7 $\,\,$ H01L $\,\,$ G11C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ, INSPEC

ategory °	Creation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
P,X	EP 1 343 154 A (MITSUBISHI CHEM CORP) 10 September 2003 (2003-09-10) page 3, line 3 -page 4, line 19 page 20, line 1 -page 21, line 14 example 3 figures 3,4	1-10
X Y		1-5,7, 9-11,14 15,16

Further documents are listed in the continuation of box C.	Patent family members are listed in annex.				
Special categories of cited documents: A' document defining the general state of the art which is not considered to be of particular relevance. E' earlier document but published on or after the International filling date. L' document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified). O' document referring to an oral disclosure, use, exhibition or other means. P' document published prior to the international filling date but later than the priority date claimed.	 "T" later document published after the International filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art. "&" document member of the same patent family 				
Date of the actual completion of the international search	Date of mailing of the international search report				
26 May 2004	09/06/2004				
Name and mailing address of the ISA European Patent Office, P.B. 5818 Patentlaan 2	Authorized officer				
NL – 2280 HV Rijswijk Tel. (+31–70) 340–2040, Tx. 31 651 epo nl, Fax: (+31–70) 340–3016	Meul, H				

In nal Application No PCT/IB 03/05648

Category °	ation) DOCUMENTS CONSIDERED TO BE RELEVANT Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Calegory	Culation of document, with indication, where appropriate, of the relevant passages	Helevani to ciami 140,
X	EP 1 202 285 A (MATSUSHITA ELECTRIC IND CO LTD) 2 May 2002 (2002-05-02) page 5, line 13-55 page 7, line 10 -page 8, line 57	1-5,7,9, 11
Y	MAIMON J ET AL: "Chalcogenide-based non-volatile memory technology" 2001 IEEE AEROSPACE CONFERENCE PROCEEDINGS (CAT. NO. 01TH8542), BIG SKY, MT, USA, 10-17 MARCH 2001, vol. 5, pages 2289-2294, XP002282220 2001, Piscataway, NJ, USA, IEEE, USA ISBN: 0-7803-6599-2 the whole document	1-5, 7-10,12
Y	BORG H J ET AL: "Phase-change media for high-numerical-aperture and blue-wavelength recording" JAPANESE JOURNAL OF APPLIED PHYSICS, vol. 40, pages 1592-1597, XP001181255 Part 1, No. 3B, March 2001, The Japan Society of Applied Physics, Japan ISSN: 0021-4922 page 1594, right-hand column, paragraph 3 -page 1597, left-hand column, paragraph 1; figure 8	1-5,7,9, 10
Υ	NJOROGE W K ET AL: "Crystallization kinetics of sputter-deposited amorphous AgInSbTe films" JOURNAL OF APPLIED PHYSICS, 15 OCT. 2001, AIP, USA, vol. 90, no. 8, pages 3816-3821, XP002282221 ISSN: 0021-8979 abstract page 3816, right-hand column, last paragraph	8,9
Υ .	GUO-FU ZHOU ET AL: "High performance media for phase change optical recording" JAPANESE JOURNAL OF APPLIED PHYSICS, vol. 38, pages 1625-1628, XP002282222 Part 1, No. 3B, March 1999, Publication Board, Japanese Journal Appl. Phys, Japan ISSN: 0021-4922 page 1625, left-hand column, paragraph 1 page 1625, left-hand column, paragraph 3 -right-hand column, paragraph 1	12
Υ	EP 0 499 273 A (ENERGY CONVERSION DEVICES INC) 19 August 1992 (1992-08-19) page 2, line 3-29 page 5, line 54-56	12
	-/	

In nal Application No PCT/IB 03/05648

0.40		C1/1B U3/U5648
Category °	ation) DOCUMENTS CONSIDERED TO BE RELEVANT Citation of document, with indication, where appropriate, of the relevant passages	
Calegory	Cualion of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WO 00/57498 A (ENERGY CONVERSION DEVICES INC) 28 September 2000 (2000-09-28) figure 2	15
Υ	US 5 714 768 A (WICKER GUY C ET AL) 3 February 1998 (1998-02-03) column 14, line 11-24	16
E	EP 1 376 594 A (HEWLETT PACKARD DEVELOPMENT CO) 2 January 2004 (2004-01-02) paragraphs '0043!,'0050!; figures 1,6,11	1-6,14, 16
E	WO 2004/032256 A (LOWREY TYLER A ;OVONYX INC (US); DENNISON CHARLES H (US)) 15 April 2004 (2004-04-15) page 5, line 21-26 page 8, line 21 -page 9, line 12 figures 1,14	1,3-6,14
Ρ,Χ	WO 03/072346 A (ENERGY CONVERSION DEVICES INC; DALY FLYNN KELLY (US); OVSHINSKY ST) 4 September 2003 (2003-09-04) page 1, line 14 -page 2, line 8 page 5, line 7-11 page 9, line 8-20	1-5,8,9
Ε	US 2004/001374 A1 (MORITA KIYOYUKI ET AL) 1 January 2004 (2004-01-01) paragraphs '0027!,'0029!,'0051!,'0062!; figures 1,6	1,3-5,8, 9,11,14

In nal Application No PCT/IB 03/05648

				PCI/1B	03/05048
Patent document cited in search report		Publication date		Patent family member(s)	Publication date
EP 1343154	Α	10-09-2003	CN	1442853 A	17-09-2003
			EP	1343154 A2	10-09-2003
			US 	2003214857 A1	20-11-2003
EP 0495494	Α	22-07-1992	US	5166758 A	24-11-1992
			AT	139862 T	15-07-1996
			CA CN	2059476 C 1064366 A ,B	27-06-1995
			DE	69211719 D1	09-09-1992 01-08-1996
			EP	0495494 A1	22-07-1992
			JP	3224253 B2	29-10-2001
			JP	5021740 A	29-01-1993
			KR	196489 B1	15-06-1999
			MX RU	9200210 A1 2130217 C1	01-08-1992
			US	5406509 A	10-05-1999 11-04-1995
			US	5534711 A	09-07-1996
			US	5536947 A	16-07-1996
			US	5596522 A	21-01-1997
			US	5534712 A	09-07-1996
			US US	5296716 A 5335219 A	22-03-1994
			U\$	5355219 A 5414271 A	02-08-1994 09-05-1995
			US	5341328 A	23-08-1994
EP 1202285	`` A	02-05-2002	CN	1351379 A	29-05-2002
		_	EP	1202285 A2	02-05-2002
			JP	2002203392 A	19-07-2002
			US	2002131309 A1	19-09-2002
EP 0499273	Α	19-08-1992	US	5128099 A	07-07-1992
			AT	227878 T	15-11-2002
			CA DE	2061187 A1 69232844 D1	16-08-1992 19-12-2002
			DE	69232844 T2	04-09-2003
			EP	0499273 A2	19-08-1992
			EP	0951011 A1	20-10-1999
			JP	4337532 A	25-11-1992
			JP KR	2002046357 A 245901 B1	12-02-2002
110 0057400					02-03-2000
WO 0057498	A	28-09-2000	AU	3769900 A	09-10-2000
			BR CA	0009308 A 2367365 A1	18-12-2001 28-09-2000
			CN	1352808 T	28-09-2000 05-06-2002
			EP	1171920 A1	16-01-2002
			JP	2002540605 T	26-11-2002
			TW	475262 B	01-02-2002
			WO US	0057498 A1 2003075778 A1	28-09-2000 24-04-2003
			US	2004038445 A1	24-04-2003 26-02-2004
			US	6617192 B1	09-09-2003
			US	2002036931 A1	28-03-2002
			US	2002045323 A1	18-04-2002
			US	2002017701 A1	14-02-2002
US 5714768	Α	03-02-1998	AU	7519696 A	15-05-1997
			CA	2231377 A1	01-05-1997
A/210 (patent family annex) (J	anuary 2004\				

nal Application No PCT/IB 03/05648

Patent document cited in search report		Publication date		Patent family member(s)		Publication date
US 5714768	Α		DE	69628674	D1	17-07-2003
			DE	69628674	T2	29-04-2004
			DE	888618	T1	02-06-1999
			EP	1326158	A2	09-07-2003
			EP	0888618	A1	07-01-1999
			JP	11514150	T	30-11-1999
			WO	9715954	A1	01-05-1997
EP 1376594	Α	02-01-2004	US	2003235063	A1	25-12-2003
			CN	1469480	Α	21-01-2004
			EP	1376594	A1	02-01-2004
			JP	2004031948	A	29-01-2004
WO 2004032256	A	15-04-2004	WO	2004032256	A1	15-04-2004
WO 03072346	Α	04-09-2003	US	2003165111	A1	04-09-2003
			WO	03072346		04-09-2003
US 2004001374	A1	01-01-2004	WO	03050872	A1	19-06-2003